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Description: CNR solutions utilize the motherboard AC'97 interface, along with processor horsepower and CPU-based digital signal processing software, to provide an overall solution that is equivalent to PCI add-in cards at or below the PCI add-in card price point.

Keywords: CNR, Communication and Networking Riser, PCI add-in card, audio, digital signal processing, CPU-based software, motherboard, system integration, Audio Codec '97 interface, AC '97.

Initiatives and Technologies

CNR Audio Solutions Reduce Costs for OEMs

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Overview

In this era of multimedia and streaming media applications, the PC audio solution is a critical component in creating the end-user's experience. In the past, motherboard audio designs revolved around expensive and complicated Industry Standard Architecture (ISA) or Peripheral Component Interface (PCI) accelerated (DSP-based) solutions, which were costly from both a bill of materials and a motherboard real-estate standpoint.

OEMs now have a method for constructing an audio solution that costs less and is more flexible than using PCI cards. Chipset vendors have begun integrating high attach rate interfaces directly into their chipsets. One of the interfaces typically included is the Audio Codec '97 (AC '97) interface, shown in Figure 1. With the integration of AC '97 into the chipset, the OEM immediately has a large portion of the overall audio solution.

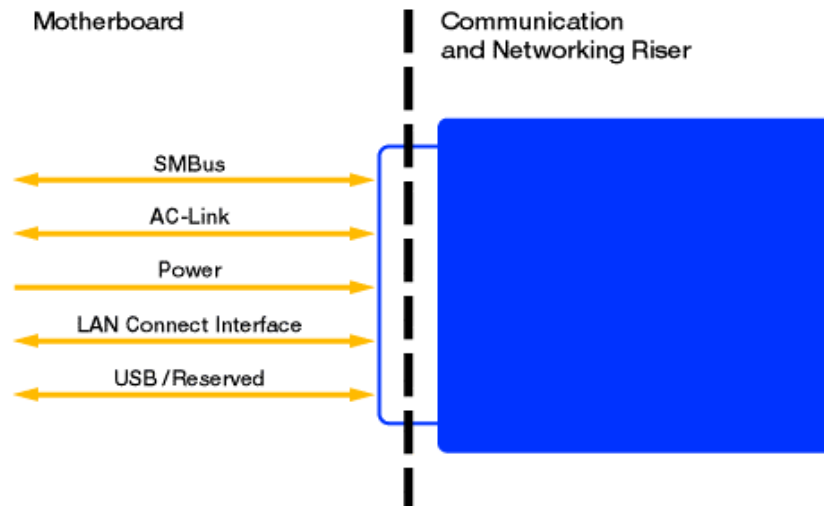


Figure 1. CNR Overview

The other part of the solution comes from using a CNR (Communication and Networking Riser) card that, together with the AC '97 interface and software, provides the same performance as a PCI card. The PC industry has developed CPU-based digital signal processing software that provides feature sets equivalent to popular PCI add-in cards. By using CNR and CPU-based signal processing software, the system integrator or OEM has the ability to supply a scalable

audio solution ranging from basic to high-end audio at a price point at or less than that of the PCI add-in card. This allows the OEM or system integrator to maintain or increase sell-up margins relative to PCI add-in audio cards, and continue support of existing business models.

CNR Audio Solutions Provide Value-added Functionality

The CNR specification provides a flexible and cost-effective way to implement an audio solution. The CNR specification is an open industry standard for desktop PC motherboard designs. The idea behind this specification is to provide motherboard designers, system integrators, and OEMs with a robust and low-cost architecture for utilizing the functionality of interfaces that are integrated in the chipset down on the motherboard.

CNR incorporates multiple motherboard interfaces on a single connector, so communication, networking, and audio building blocks can be easily incorporated onto a single card. This provides OEMs, manufacturers, and system integrators with the flexibility to integrate audio functionality as a value-add. It also enables them to develop multi-function cards for specific market segments, such as audio plus 10/100 Ethernet for the corporate market, or audio plus modem for the consumer market.

High-Speed Software Eliminates Need for Accelerators

In the past, PCI hardware accelerators have been used to ensure that PC audio was free of aberrant effects, such as audio dropouts due to variation in system bandwidth caused by other devices within the PC. In addition, many of these PCI accelerators have been capable of performing various effects such as reverb, flanging, chorus, sample rate conversion, and virtual surround technologies such as head-related transfer functions (HRTF), 3D positional, and environmental audio. A typical PCI/AC '97 hardware accelerated audio solution is shown in Figure 2. When the user plays back a WAV file, the data is retrieved by the PCI controller, processed by the accelerator's DSP, converted to AC '97 format, and sent over the AC '97 interface to the CODEC. The audio CODEC then converts the PCM audio data to an analog output, which is passed to the back or front panel jacks, and ultimately to the PC speakers.

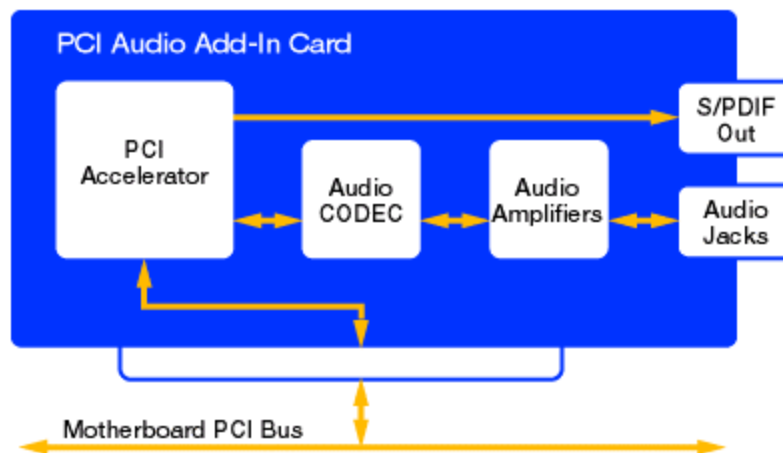


Figure 2. Standard PCI Audio Card Architecture

Today's high-speed processors have the horsepower needed to perform these DSP effects in software without excessive use of processor bandwidth. The development of CPU-based audio digital signal processing software, in combination with CNR, enables a new set of audio hardware configurations.

CNR-based Solutions Eliminate Need for Multiple SKUs

The CNR is a value-add to the OEM or system integrator because it allows multiple audio solutions to be designed for a single motherboard SKU. Previously, the OEM had to manage multiple SKUs of a given motherboard when different audio options were required. OEMs would, for example, take an audio and non-audio SKU for a given motherboard. This allowed the OEM to productize a system with basic audio down on the motherboard and a system with a high end PCI audio solution on a non-audio down SKU of the same motherboard. CNR allows for these options plus several audio upgrade options with a single SKU of the motherboard.

Figures 3a & 3b shows some examples of possible CNR and motherboard/CNR audio solutions. Note that the CNR can also be used as an OEM or system integrator upgrade path for audio where audio down on the motherboard is used in conjunction with a CNR audio solution to create a scalable multi-channel solution that enhances the end-users' experience.

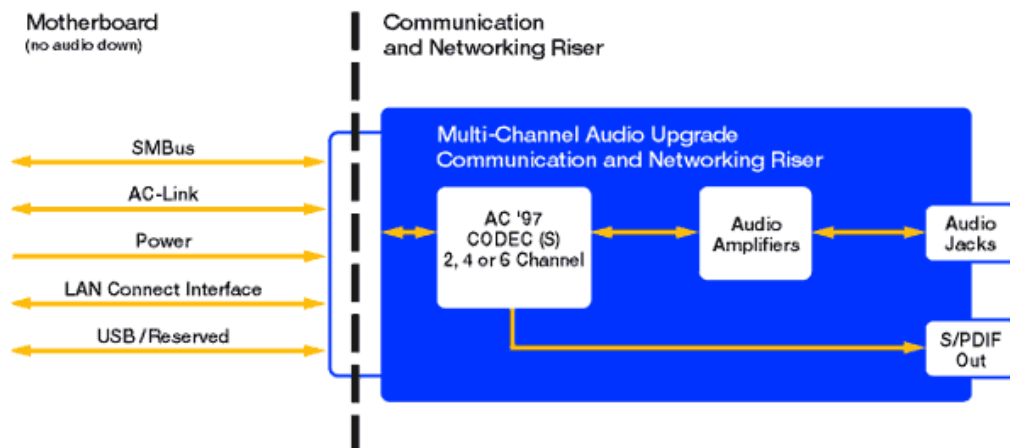


Figure 3a. Audio on CNR and No Audio Down on the Motherboard

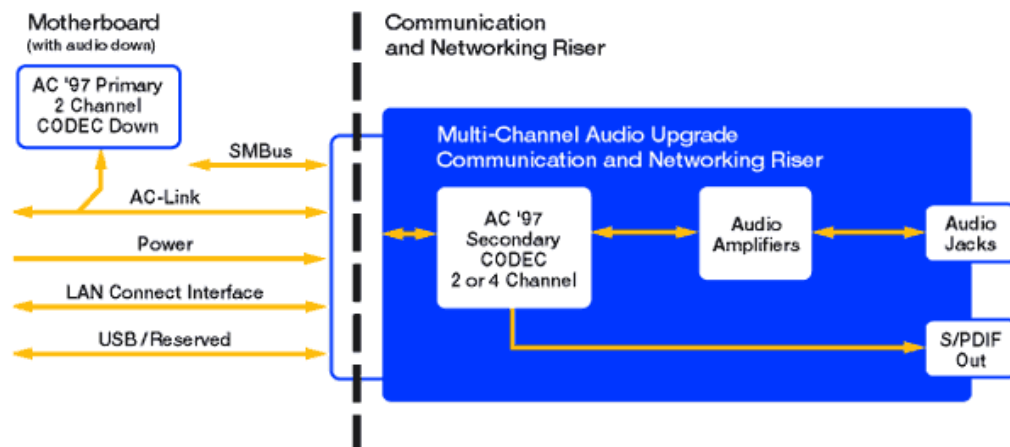


Figure 3b. Multi-Channel Audio Solution Split Between CNR and the Motherboard Audio Solution

Summary

CNR solutions utilize the motherboard AC '97 interface, along with processor horsepower and software-based digital signal processing software, to provide an overall solution that is equivalent to PCI add-in cards at or below the PCI add-in card price point. OEMs benefit by taking full

advantage of the AC '97 interface they are already paying for when they purchase a chipset, instead of paying additional cost for PCI add-in audio cards. In addition, the number of motherboard SKUs is reduced, making inventory management much simpler.

More Info

For more information on CNR-based audio solutions, visit:

- [Intel's Communications and Networking Riser news Web site](#)
- [An overview of CNR technology and CNR's place in the retail market](#)
- [Questions and answers about the CNR specification](#)

Author Bio

Philip R. Lehwaldter joined Intel in 1995 as a college intern for the Military Special Products Division. He then moved directly to OPSD, where he worked on motherboard audio and modem design. Philip holds an electrical engineering degree from the University of Washington.